ILLUSTRATED CATALOGUE.

PRACTICAL HINTS

UPON

DRAINAGE

SEWERS,

SEWER PIPE

AND

FIRE BRICK.

JACKSON FIRE CLAY COMPANY,

JACKSON, - MICHIGAN.

R. CONNABLE, Secretary and Treasurer.

JACKSON CITIZEN PRINT.

1873.

ILLUSTRATED CATALOGUE

OF

SEWER PIPE

AND

FIRE BRICK,

Manufactured by the

JACKSON FIRE CLAY CO.

ALSO

PRACTICAL HINTS AND DIRECTIONS.

R. CONNABLE, Secretary and Treasurer,

JACKSON, MICHIGAN.

JACKSON CITIZEN PRINT.

1873.

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TO OUR PATRONS:

In presenting to you this Catalogue we have endeavored to throw some light upon the various purposes to which our goods are applied.

It is well understood, by those best qualified to judge, that drains made of suitable materials and properly constructed are indestructable; that they are always in good working order, and, as a rule, never get out of repair.

But it is equally well known that large amounts of money have been expended, both in this country and in Europe, for sewers and drains that in a few months or years have become entirely useless.

All this has resulted from the want of a knowledge of the first principles of drainage, and a due regard to the necessity of using suitable materials and doing the work in the most thorough manner.

We therefore here present, in as concise a form as possible, some practical information and selec-

tions from the best authorities upon the leading and well-established principles of drainage; all of which, we believe, are approved and adopted by American and European engineers of the largest experience, and which, we trust, will be found useful to those desiring information upon this subject.

JACKSON FIRE CLAY CO.

Jackson, Mich, May, 1873.

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NOTE.—The three or four smaller sizes of pipe designated on the next page, are made with sockets, and are designed especially for conveying pure water, for domestic purposes, from springs or lakes.

PRICE LIST

Of Standard Sizes of best Vitrified, Salt-glazed Water and Sewer Pipe, delivered on the cars at Jackson :

Caliber of Pipe.	Weight per foot.	Area in Inches.	Price per foot.	Slants per foot.
1 in.	3 lbs.	785	$ 8	$----
1½ "	5 "	1.767	10	----
2 "	7 "	3.141	12	----
3 "	8 "	7.068	15	----
4 "	10 "	12.566	20	----
6 "	15 "	28.274	30	45
9 "	30 "	63.617	50	75
12 "	45 "	113.09	75	1 15
15 "	65 "	176.71	1 00	1 50
18 "	80 "	254.46	1 50	2 25
20 "	85 "	314.16	1 75	2 65
22 "	90 "	380.134	2 10	3 15

Caliber of Pipe.	Curves and Elbows, each.	Branches 2 feet long, each.	Traps each in two pieces.	Whole Traps, each.	Hand-hole Traps, each.
1 in.	$ 25	$ 25	$----	$----	$----
1½ "	30	30	----	----	----
2 "	40	50	----	1 00	----
3 "	50	60	----	1 20	1 70
4 "	60	80	----	1 60	2 10
6 "	1 00	1 20	2 00	2 40	2 90
9 "	1 75	2 00	3 50	4 00	4 50
12 "	2 75	3 00	6 00	8 00	8 50
15 "	3 75	4 00	8 00	10 00	10 50
18 "	4 75	6 00	----	----	----
20 "	5 75	7 00	----	----	----
22 "	7 00	8 40	----	----	----

Perforated Traps for damp cellars,	4x 9,	$2.50 each.
" " "	4x12,	3.00 "
Grease and Stench Traps for house drains,	6x18,	5.00 "
" " " "	6x20,	6.00 "

Prices of pipe with ONE BRANCH are given on page 6. Each additional branch, 50 cents.

Discounts from these prices will be made to Corporations, Railroads and Contractors according to the amount purchased and terms of payment, which will be given upon application.

Prices of Defective Pipe on	page	56.
" Stone Chimneys	"	58.
" Fire Brick	"	81.
" Fire Clay	"	82, 83.
" Fire Sand	"	83.

TERMS, CASH; if not remitted within 30 days, subject to sight draft.

All bills payable at Jackson in bankable funds or New York exchange.

If remittances are made by express, charges should be prepaid.

STANDARD PATTERNS OF PIPE.

Fig. 1.



Straight Pipe.

Fig. 2.



Curve.

Fig. 3.



Elbow.

Fig. 4.



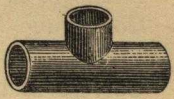
Slant.

Fig. 5.



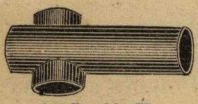
Ring.

Fig. 6.



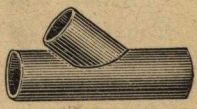
6x6 T Branch.

Fig. 7.



6x6 Double T.

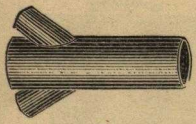
Fig. 8.



6x6 Y Branch.

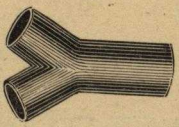
2.4xH"
R.C.W

Fig 9.



4x6 Double **Y**.

Fig. 10.



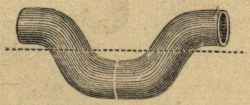
6x6 **V** Branch.

Fig 11.



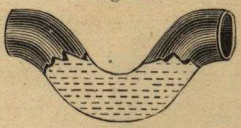
6x12 **Y**.

Fig. 12.



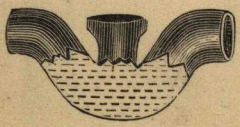
Two-Piece Trap.

Fig. 13.



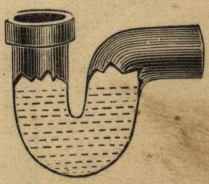
Whole Trap.

Fig. 14.



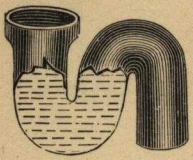
Hand-hole Trap.

Fig. 15.



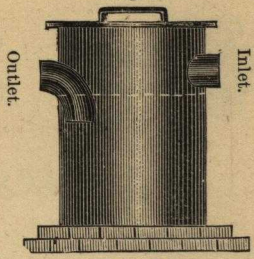
P Trap.

Fig. 16.



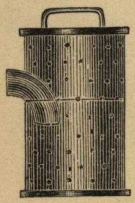
S Trap.

Fig. 17.



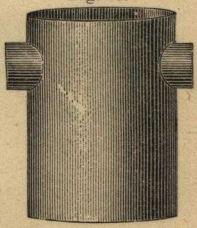
6x18 Catch Trap.

Fig. 18.



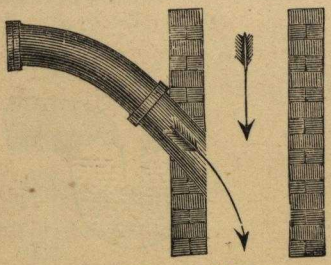
Cellar Trap.

Fig. 19.



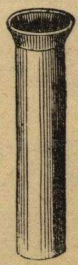
Catch Basin.

Fig. 20.



Junction of Pipe with Brick Sewer.

Fig. 23.



Socket Pipe.

DIRECTIONS FOR

LAYING SEWER PIPE.

It is of the utmost importance that the grade of the fall be uniform and free from depressions.

This is most easily accomplished by stretching a line eight feet above the bottom of the proposed ditch, giving it the grade or fall desired in the sewer, and supporting it by cross bars, to prevent it from sagging.

A light rod eight feet long, reaching from the line overhead to the bottom of the ditch, will enable any inexperienced workman to prepare the bed for the pipe on exactly the same grade as the guide-line overhead. In laying the pipe, shorten the rod so as to reach from the guide-line to the top of the pipe.

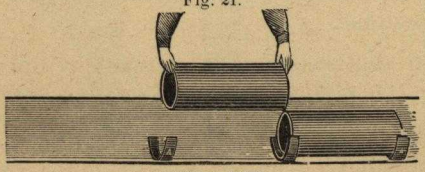
When the bottom of the trench is too soft to support the pipe in line, a few inches of gravel will make it sufficiently solid.

Never put in plank or boards unless they are

buried several inches below the bottom of the ditch, where they will be protected from the air in the drain—otherwise they will decay and allow the pipe to settle, making a depression that will be likely to fill with solid matter. Beside this, the whole pressure of earth above the pipe must be sustained by the very small bearing surface upon the plank—which might be sufficient to crack the pipe.

When a water-tight sewer is desired, the rings should be broken in several pieces. Spread a layer of cement about one-half inch thick over the concave surface of one of these pieces, and lay the ends of two pipes thereon—butting them firmly together. Cover the upper surface of the pipes at the joints with a layer of cement of sufficient thickness to allow the remaining pieces of the ring to imbed themselves; cover all around the edges of the ring with the cement and press it firmly in the corners and cracks and smooth it off, swabbing the cement from the inside of the pipe. *Before filling the ditch, pack the fine earth under and around the pipe after the cement has hardened.*

Fig. 21.



LAYING PIPE.

Fig. 22.



PIPE LAID

One part of good, live, quick-setting water lime, with two parts of clean, sharp sand, makes good enough cement for ordinary use.

For sewerage purposes it is important that the joints be perfectly tight, otherwise the water will escape from the pipe and undermine it, beside leaving the more solid matter to obstruct the sewer. Leaky joints also prevent successful "flushing." Obstructions in small sewers are most generally removed by "flushing," or a pressure of water. When a force pump cannot be readily obtained for the purpose, a perpendicular pipe of any material attached to the upper end of the sewer and filled with water will force a passage to the terminus.

By the construction of a cesspool, and a judicious use of the waste water from kitchen, bath-room, laundry and roof, any residence can be supplied with efficient water closets and all the modern benefits of sewerage that are enjoyed in cities.

To cut these pipes to any required length, mark the line to be cut, use a good cold-chisel, with a

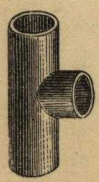
diamond-shaped point, and a light hammer. Strike the chisel lightly and carefully all around the line until the top surface is cut away, and then repeat until the pipe comes nicely apart.

For the purposes of land drainage the joints should be covered with gravel or tame grass sod, with the grass side next the pipe. Marsh hay is sometimes used when the above are difficult to obtain—but is not so desirable.

(See defective pipe.)

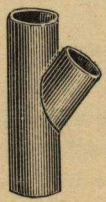
JUNCTIONS OR BRANCHES.

Fig. 6.



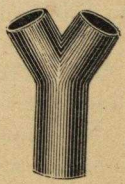
T Branch.

Fig. 8.



Y Branch.

Fig. 10.



V Branch.

The branches on all pipe larger than six inch should be smaller than the main.

We keep in stock Y branches of all sizes, also

4 in.	pipe with	4 in.	Y and T	Branches.	
6	"	" 4 and 6 in.	"	"	"
9	"	" 4, 6 and 9 in.	"	"	"
12	"	" 4, 6, 9 and 12 in.	"	"	"
15	"	" 4, 6, 9 and 12 in.	"	"	"
18	"	" 4, 6, 9, 12 and 15 in.	"	"	"
20	"	" 4, 6, 9, 12 and 15 in.	"	"	"
22	"	" 4, 6, 9, 12 and 15 in.	"	"	"

Y junctions should be used whenever practicable, so that the two currents may flow in the same direction.

TRAPS, CATCH BASINS, &c.

All traps are so made as to interpose a body of water between the atmosphere we breathe and that contained in the sewers. The full benefit of sewerage, therefore, cannot be obtained without their judicious arrangement, to prevent the noxious stench from the sewers passing up the connections and poisoning the air in our dwellings.

CATCH TRAPS.

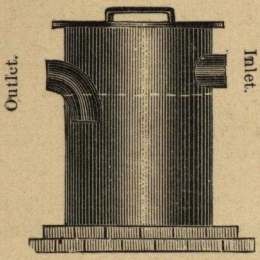


Fig. 17.

CATCH TRAPS should be set upon a brick bottom and made perfectly tight with water lime cement.—Place them where they will not freeze in winter, and will be accessible for cleaning once in a year or two. They are so constructed as to retain every substance that would be likely to obstruct the sewer.

Grease, (THE WORST OF OBSTRUCTIONS) and all other floating matter will, on entering the catch trap, rise to the surface of the water and be arrested by the curved outlet, while all matter much heavier than water will be deposited on the bottom.

Either a Running or P *Trap must be placed between the Catch Trap and the house.* For convenience in cleaning, it is well to place it next the catch trap. But this small matter of convenience should be dispensed with rather than to have much length of sewer between the trap and hopper, especially if it is not ventilated.

Soil from water closets should not pass through a catch trap, for obvious reasons.

If it be desirable to place the catch trap in an angle of the sewer, we can furnish a "right" trap, through which the current or flow takes a quarter turn to the right, or a "left," through which the flow takes a quarter turn to the left; but when neither is specified, we always send those in which the inlet and outlet are opposite each other, as in Fig. 17.

RUNNING TRAPS.

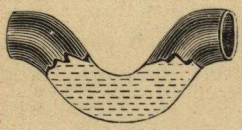


Fig. 13.

RUNNING TRAPS may be used effectually where a catch trap is not desirable. With ordinary care they seldom become obstructed, and are readily cleansed under pressure, described on page 15. In obstinate cases, however, the hand-hole trap is found very convenient, as shown in Fig. 14.

HAND-HOLE TRAPS.

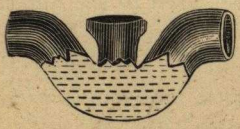


Fig. 14.

In placing this trap, the hand-hole is closed with a cover in such a manner that it can be readily opened when necessity requires. When

they are located much below the surface the hand-hole may be lengthened by setting in a joint of pipe, through which the trap may be cleaned when desired.

P TRAPS.

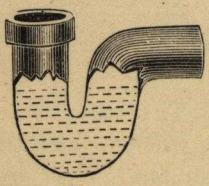


Fig. 15.

P TRAPS are used at the head or upper end of a drain, or under the bowl of water closets. It forms a perfect trap, and is preferable in such places, as the soil from the hopper falls directly into the water, and therefore will not adhere to the pipe. This form of trap has also the advantage of a perpendicular fall of sewerage to assist in dislodging solid matter.

S TRAPS.

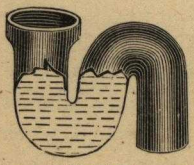


Fig. 16.

S TRAPS are used in the upper stories of buildings, as a P trap would be. They are really P traps, arranged to connect with a perpendicular pipe.

CELLAR TRAPS.

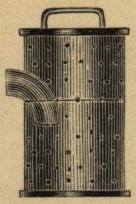


Fig. 18.

DAMP CELLARS.—In draining a wet cellar it is as desirable to remove the water from below, as from above the floor level, otherwise it will be damp, sour and unhealthy, though there may be no water visible.

For this purpose our cellar traps are almost indispensable. The sides are perforated for the free admission of water.

In setting them, dig a hole in the center of the cellar as deep as possible, allowing sufficient fall from the outlet of the trap to the terminus of the cellar drain.

Have the hole sufficiently large to admit a coat of clean, coarse gravel, six or eight inches thick, under the bottom and around the sides of the trap. When the drain is connected to the trap the whole may be covered and the cellar bottom grouted. All water will filter through the gravel and perforations into the trap and flow off through the drain, *no water in the soil ever rising higher than the outlet of the trap.*

The trap and drain can never become obstructed by rats, sand or other matter, and the elbow extend-

ing below the surface of the water prevents any stench from coming into the cellar from cesspools or sewers.

We keep in stock those with inlets, same as in catch traps; so that when two or more are required they may be made to operate together by connecting them with pipe.

CATCH BASINS.

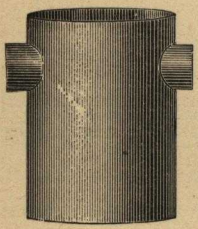


Fig. 19.

Catch Basins are designed to be placed in long lines of pipe, more especially in land drainage. They catch and retain any sand that may wash into the pipe, and are convenient in removing obstructions.

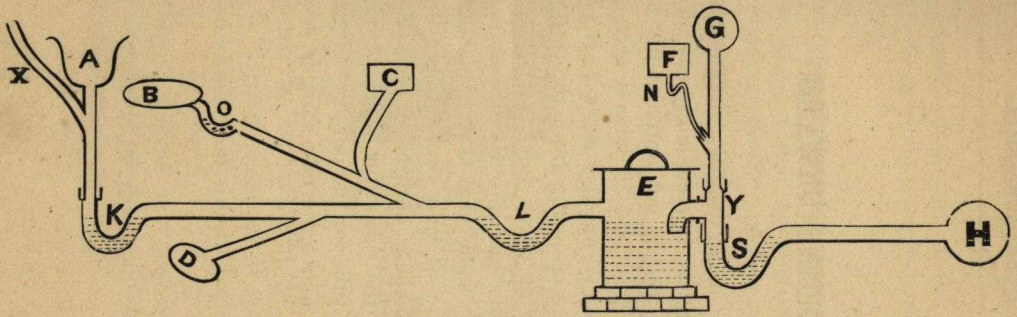
Catch basins, having three or four branches or inlets, furnish an excellent method of connecting several drains into one.

They also serve as "peep-holes" for examining the working of the drain and determining the location of obstructions.

VENTILATING SEWERS.

It will be seen that under ordinary circumstances the foul air of the sewer is completely cut off by the use of the trap. But it not unfrequently happens that the gases generated in long sewers, and especially in "cesspools" or "dry wells", are powerful enough to drive the water from the trap and force their way out at every inlet. To prevent this overflow of sewer gas into residences, fix an upright tube of the same area as the inlet pipe, if possible, above one or more connections to the drain. Sometimes these upright or ventilating tubes connect with the rainwater pipes or chimneys, but a separate tube for the purpose terminating in the open air above the first story is preferable.

SEWERAGE ILLUSTRATED.



A, hopper or sink for the reception of kitchen slops. **B**, cistern. **C**, laundry. **F**, bath room. **G**, water closet. **H**, terminus of the house drain (either a street sewer or a cesspool). **X**, ventilating flue, the uses of which are explained on page 23. The **P** trap, **K**, prevents stench from passing into the kitchen. The cellar trap, **D**, drains the damp cellar. The cistern overflow is supplied with the trap, **O**, to prevent the gases of the drain entering the cistern and contaminating and souring the water (which is a great absorbent of gases). The laundry, **C**, should also be trapped, if necessary. **L** is a running trap, cutting off the foul air generated in the catch trap, **E**. The soil from the water closet, **G**, falls directly into the water at **S**. The trap, **N**, is formed by bending the lead pipe which conducts the water from bath room. The catch trap, **E**, retains the floating and solid matter, as explained on page 18, allowing the fluids to assist in cleansing the water closet trap, **S**. The main pipe, running from **K** to **H**, is of 6 inch capacity, all the connections being of 4 inch pipe.

SEWERAGE ILLUSTRATED.

On the preceding page is illustrated the principle of house drainage, the details of which may be varied to suit the exigencies of each particular case by any person of intelligence. By this arrangement of traps and connections all the waste water of the house is utilized in such a manner as to insure the constant and most perfect operation of the whole system.

CAPACITY OF SEWER PIPE.

The capacity of pipe of the various sizes given in the following table are calculated for a fall of six inches to one hundred feet, without any head, according to the formula given by Prony for the flow of water in tubes. This table will assist greatly in determining the size of any required sewer, and should be consulted in connection with

the rules so clearly stated in the following pages under the head of STANDARD AUTHORITIES ON GENERAL SEWERAGE.

Size of Pipe.	Length of Pipe	Fall of Pipe.	Capacity of Pipe per Minute in Gallons.
4 inches.	100 feet.	6 inches.	75 gallons.
6 "	"	"	213 "
9 "	"	"	576 "
12 "	"	"	1,220 "
15 "	"	"	2,108 "
18 "	"	"	3,306 "
20 "	"	"	4,320 "
22 "	"	"	5,498 "

In main sewers the flow is increased by the added pressure of connecting laterals.

We have been at much pains to obtain data from the most responsible and eminent sources, and find that some engineers of extended reputation and experience, in estimating the capacity of sewers, allow to pipe an advantage in carrying capacity of 50 per cent.; while *none allow less than* $33\frac{1}{3}$ *per cent. in favor of pipe, as compared with brick sewers of same size.*

In addition to the advantages named, and the difference in the size required to do a given amount of drainage, there is a large saving in the excavation necessary to receive a pipe sewer, the

shell being but 1¼ inch thick. In threatening weather also, or in passing through treacherous ground, the work may be completed as fast as the excavating can be done, and in quicksand or springy ground the advantage in laying pipe is obvious.

All the above points may appear to the eye of inexperience as of small moment, but are most thoroughly understood and appreciated by the most successful of our engineers and large contractors.

STANDARD AUTHORITIES ON

GENERAL SEWERAGE.

The following extracts are taken from the report of the Board of Water Commissioners of the city of Brooklyn, to which Mr. James P. Kirkwood, an engineer of eminent ability, was Chief Engineer, with Mr. Julius W. Adams, of long experience, associated with him as Consulting Engineer, in special charge of the sewerage system. In consideration of the ability and experience of both the gentlemen named, said report has been accepted as authoritative by the best civil engineers and Boards of Public Works throughout the United States:

"Previous to 1850, or thereabouts, the sewerage drains of many English cities had been established so as to receive the house sewerage as well as the street sewerage, or rainfall, but the water supply of the same cities being then deficient in the quan-

tity used per head of population, as compared with our present habits, the resulting fluid sewerage of dwelling houses was not sufficient in quantity to carry off the heavier matter which accompanied it. This last, therefore, when it reached the sewer deposited itself there in part, and accumulated upon the bottom until carried away by the waters of heavy rains or removed by manual labor. These accumulations frequently remained long enough to become putrescent, and, by their decomposition, exceedingly offensive to health and sense. The aggravations of sickness which grew out of this state of affairs are matters of history, not likely to have place again, to the same extent, in our times. The sewers under this system were all built of sufficient size to admit of their being cleaned out at intervals by manual labor.

"The introduction into the same cities, and gradually into all important cities, of more abundant supplies of water, admitting of its free use for the luxuries as well as the mere necessities of domestic life, paved the way for a change in the modes of sewerage previously prevalent.

"This change consisted in the introduction of smaller sewers, the sizes of which where governed solely by the amounts of sewerage and rain water to be passed at any given point; their enlargement beyond the requirements above mentioned was con-

sidered unnecessary, and in other respects objectionable.

"The opinions of English engineers as regards this innovation were very various and contradictory. The general correctness of the views of those who originated it is now sufficiently established by experience. In the change of system the application of pipe sewers was incidental. The true controversy lay between small sewers for drainage only, and large sewers for drainage and entrance also.

"The smaller sewers, taking the shape within certain limits of pipe sewers, originated in the motive of economy; but their continued application was the result of other advantageous conditions which will appear as we proceed.

"The ruling principle insisted on, and, we presume, generally admitted now, is this: that *each day's sewerage of each street, and of each dwelling, should be removed from the city, if at all practicable, on the day of its production;* that it should pass off before decomposition begins; that it should not be allowed to settle and fester in the sewers, producing those noxious gases which are so prejudicial to health. This principle requires that the sewerage matter of any one day shall not be found within the limits of the city on the next day.

"If the rate of inclination of a sewer is not flatter

than one foot in four hundred and forty, the experience of Brooklyn, and other cities equally well supplied with water, shows that the fluid domestic sewerage of any street is competent to carry off daily all the heavier matters of sewerage, and to keep the drains free and clean, provided that the form of the sewer is such as to concentrate these sewerage waters as much as possible.

"If the sewer is made unnecessarily large, the depth and velocity of the fluid passing through it are proportionally reduced, and its ability to keep itself clear will be confined to high rates of inclination. It is important, therefore, to have it as small as the service to be required of it will admit.

"As regards the necessity of entering sewers, which was dwelt upon so much ten years ago, the successful use of the small sewers shows that this necessity does not exist; they have been found safe and effective when properly built, and less troublesome as regards cleansing, than the old sewers.

"Their most important advantage, indeed, grows out of what was contended to be their great defect, viz: Their incompetency to receive or admit of sewerage deposits or accumulations. They presuppose the daily removal of all sewerage matters; and this condition is always necessary to their efficient operation.

"In Chicago, where pipe sewers of twelve inches diameter are used with an inclination of one in five hundred, a tank placed on wheels has been used wherewith to flush them occasionally. Where, however, the leaders of the dwelling houses are connected with the house drains this precaution has not been found necessary. I have this information from Mr. E. S. Chesbrough, the City Engineer of Chicago, whose researches and experience in sewerage matters are well known, and have been always very obligingly communicated.

"The point being conceded that the greater the concentration of the minimum flow (in other words, of the sewerage proper) the greater will be its carrying and cleansing power in a sewer of any given inclination, and the concentration being greater as the sewer is smaller, the minimum sizes of sewers practicable come next under consideration. The conditions governing the size of a sewer at any one point are these:

"1. The amount of the sewerage proper passing that point.

"2. The amount of rainfall passing that point.

"3. The inclination of the sewer.

"*The extremes of rainfall mainly determine the sizes of sewers, the household sewerage being a very small item in comparison.*

"A rain storm of one inch rainfall in one hour has been taken by Mr. Adams as the maximum of rain to be provided for. He estimated that from various causes, such as detention in street gutters and conductors from roofs and loss of time in getting into the sewer, where one inch of rain fell within one hour, not more than one-half of the resulting quantities of water reached the sewer within the same hour; one half inch of rain in one hour became, therefore, the maximum of rainfall as regards sewer dimensions.

"Every junction, whether of sewer or drain, should enter by a curve of sufficient radius. All turns in the sewer should form true curves, and as even in these there will be more friction than in the straight line, a small addition should, at curved points, be made to the inclination of the sewer.

"The pipes generally used in the Brooklyn sewerage works have been strong, glazed earthenware pipes of twelve, fifteen and eighteen inches diameter. No pipes of less than twelve inches diameter have been used for a street sewer, although the entering sewers from dwellings do not exceed six inches in diameter.

"For *the flow of sewerage the glazed pipe is far superior to the brick sewer*, and now that we have had considerable experience of them,

it is surprising that we do not venture, as in England, upon sizes exceeding eighteen inches diameter, up to twenty-four inches at least. The pipe sewer has a joint every twenty-four inches; the brick sewer has a joint every eight and a half inches longitudinally, and every two and a half inches transversely. These mortar joints do not always remain tight. Whether from the use, occasionally, of ill prepared mortar, or by some action of the sewerage matter on the mortar, they frequently leak.

"If the leakage is inwards it will assist the flow; but if the leakage is outwards, as will generally be the case, it deprives the heavy matter of the sewerage proper of its fluid motor, and must lead to some settlement and deposit on the bottom, as a matter of course. The leakage is objectionable, besides, as containing in some measure that impurity of the subsoil which it was the object of sewerage works to correct.

"In all this the advantage is entirely with the pipe sewer, and it is for that reason worth more to the city than a brick sewer of the same size, and a larger price, if need be, might well be paid for it.

"The cheapest mode of building sewers is not, in my opinion, the best, while a more perfect mode is within reach at but little extra expense.

"The roughness of all brick sewers, however well built, as compared with proper pipe sewers, and the foothold they give to rats, might well lead us to dispense with their use except for sizes where the more perfect mode becomes impracticable or unsafe."

JAMES P. KIRKWOOD.

Chief Engineer Brooklyn Board of Water Commissioners.

DR. JAMES JOHNSON, *Health Officer of Milwaukee, Wis.*, in an article on sewers, says:

"Experience has proven that by giving a sewer a suitable form and adjusting the size to the amount of drainage it is to receive and carry off, it will become self-cleansing.

"Experience has likewise proven that pipe sewers are preferable to brick, and should be used almost exclusively in the construction of our system of sewerage. Formerly sewers were almost exclusively built of porous brick, and large enough for a man to enter and clean out; but experience has fully demonstrated that pipe sewers are much more economical and efficient. The principle which justifies their use is, that the rapidity of a flow of water and its power to remove obstacles, *is in its depth as compared to its width.*

"Of all the cities of the world, London, England, has had the most experience for a thorough and perfect system of sewerage. But it was many years, and after large amounts of money had been expended, that the following results were arrived at: That brick sewers large enough for men to travel through are more costly and less efficient than necessity requires; that the absorbent power of the brick, and the rough surface of the coarse brick and mortar work are not so well suited as a pipe with a smooth bore, for the steady and complete transmission of whatever flows (or ought to flow) through the drain; that the drainage of a town by means of such pipes, their right proportion having been first carefully ascertained and adopted, would be perfect, and about one-third the cost of the inefficient mode of drainage formerly used.

"We have positive evidence of the advantage of small pipe sewers, if properly constructed, to do the work which *large sewers failed to perform.* This was demonstrated by a sewer three feet wide, with a fall of one foot in 118 feet, having the deposit of 1,200 dwelling houses emptying into it, and permitting 6,000 cubic feet per month to accumulate.

"This immense deposit was entirely obviated by a pipe sewer 15 inches in diameter, with a fall of one

foot in 153. This small sewer did not leave an atom of matter to stagnate or rot."

JAMES JOHNSON, M. D.,
Health Officer of Milwaukee, Wis.

The following extracts are from works upon the SEWERAGE OF LONDON, ENGLAND, by G. R. Dempsy, Esq., and other engineers of equal eminence and ability:

"We have already insisted on the necessity of so arranging and constructing the sewers of a town that they shall not require any cleaning by hand, and have denied the condition of admitting workmen as an essential one in determining the size of sewers. A sewer cannot be considered as properly constructed if it retains the matter committed to it in a quiescent condition. It should act simply as a place of passage, and instantly transfer the sewerage onwards toward the outlet. Failing in this purpose, and containing all the solid matter in a constantly-growing accumulation, the sewers of a town act as combined cesspools, and the several inlets serve as the outlets for the escape into the atmosphere of some of the deadly gases constantly engendering below.

"The expense of cleansing by hand is, moreover, an item of considerable importance, although, of

course, never incurred until the subterranean nuisance becomes intolerable.

"As illustrating the question of the proper size of sewers, I would give the result of an experiment by the Metropolitan Sewerage Commission of London: In the case of a sewer 5½ feet high and 3½ feet wide, draining an area at its inlet of 44 acres, a twelve-inch pipe was inserted for a length of 560 feet in the main sewer, a head-wall was built, closing up the inlet, and thus forcing the sewerage from the whole area to pass through the pipe. It was found that the drainage power of the pipe was twenty times that of the old sewer (in proportion to its area), and in place of the deposits that had existed in the old sewer to a very great extent, stone, brick, &c.—in fact, all matters drained into it—were carried through.

"Other experiments demonstrated that pipe sewers, from twelve to eighteen inches diameter, with grades of one in 20 to one in 240, would drain from 5 to 20 acres, with 160 to 600 fourth-class houses. They were found to do the service more effectually than brick sewers of three or four feet diameter, built for the same service.

"For the smaller sewers the 'glazed stone ware' pipes are found efficient substitutes for those built of brick work. They have the advantages of

being much more quickly laid than the others can be built, and of presenting a very superior surface for the rapid passage of the sewerage. They are also constructed in various forms of bends and junction-pieces, and thus afford the means of insuring proper form in these points. From their comparative thinness, pipes of this kind afford a much larger capacity with a given quantity of excavation for laying them, than sewers formed of brick-work, which, even for the smallest diameter, cannot be less than half a brick, or 4½ inches, in thickness.

"A 6-inch pipe, laid with sufficient fall, will be ample for the most capacious private house; and from 9 to 15-inch will, under similar conditions, be sufficient to serve the average drainage of factories and other large consumers of water. The trapping of the head of the drain, so as to prevent the ascent of the smell and impure gas from the drain into the building, is the next indispensible requirement in the draining apparatus.

"The upper connections of the minor sewers with the house-drains are small works, requiring the greatest care and circumspection.

"They are frequently disregarded and carelessly executed, because they appear, individually, trivial matters; and, moreover, are troublesome and te-

dious, and correspondingly expensive. But it is clear that the efficiency of the entire arrangement of any system of town drainage is primarily dependent upon the completeness with which the individual drains of houses convey the separate contributions of sewerage into the minor or branch drains. If these tributaries fail, the trunk of course remains idle, and all care bestowed on the larger works is thrown away."

SEWERAGE OF

TOWNS AND CITIES.

The preceding extracts from STANDARD AUTHORITIES ON GENERAL SEWERAGE apply especially to the drainage of towns and cities, and comprise the more important conditions necessary to secure the most successful results.

The following directions are selected from the same and other authorities on

LATERAL CONNECTIONS.



Fig. 11.

In the construction of street sewers of stone pipe, 6-inch branches (as shown in Fig. 11) should be placed opposite every building lot, and the ends closed until such time as the owner may wish to

connect with the sewer. Branches of larger size should also be placed at such points as will be necessary to receive the lateral sewers from other streets. Where the main sewer is made of brick, these branches are introduced by the use of slants, as shown in Fig. 4.

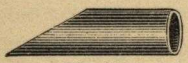


Fig. 4.

These slant junctions are built into the wall of the main sewer, the bevel of the slant being flush with the inside of the brick work—thus forming a Y junction. Slants larger than 9 inches are made "rights" and "lefts"; and the bevel of each is cut so as to fit the inside sweep or circle of a large brick sewer when properly placed.

Lateral connections to these branches are made by the use of a curve, as shown in the following figure:

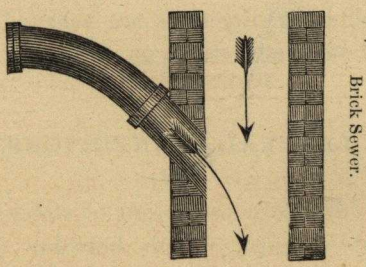
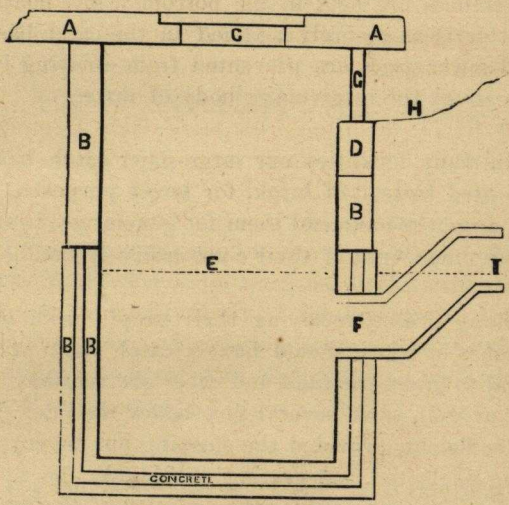


Fig. 20

SURFACE WATER.

We here present a cut of the catch basin in most general use, through which surface water is admitted to the sewer:



Street Catch Basin—Scale, ¼ in. to the foot.

These are generally located under the corner of the side walk, in the angle of the gutters, at street crossings. **B** is an 8-inch brick wall. The continuous layer of concrete is to make it water-tight below the outlet. **F** is half of a pipe trap (generally 9 or 12-inch), which is connected at **I** with a

curved pipe leading to a branch in the main sewer. **D, A** and **C** may be either hard wood or stone. **C** is the man-hole through which the basin is cleaned as often as required. The water from the gutter, **H,** passes through the grate bars at **G,** and readily finds its way to the sewer. Sand and other heavy substances are held in the bottom, while floating matter is as securely retained in the catch basin, and sewer gases are prevented from escaping into the air by the intervening body of water.

In many localities our large-sized catch basins are used instead of brick, for street purposes, but we do not recommend them for general use in such cases on account of their comparatively small size.

Long drains, receiving their supply from open ditches or lakes, should have a catch basin at the head to arrest the sand and other obstructions. A pit or well, sunk several feet below the inlet, will be sufficient, provided the cleaning out be not too long neglected. A grating should also be so arranged as not to reduce the capacity of the pipe.

(See "Experiences with Cement Pipe," page 61.)

STONE PIPE

FOR RAILROAD USE.

For small water-ways under the road bed of railways, to transfer water from one ditch to the other, for use in deep cuts, and for laying in ditches under wagon-road crossings, sewer pipe is rapidly coming into favor with railroad men, and is destined to supersede all other material.

The engineers of the older, and the Western States, having tested them thoroughly in practical use, for many years, are now replacing wooden culverts with pipe, and using them in every place where their carrying capacity is sufficient for the work required. In many places, also, where a single pipe is not of sufficient capacity to dispose of the water, they lay a sufficient number of pipes abreast to meet the requirements of the case.

We here append the reports of two Railroad Engineers of long experience in the use of stone pipe, showing the estimate placed upon them by those who have thoroughly tested their merits for railroad purposes:

"SEDALIA, MO., April 4, 1872.

"My first use of stoneware pipe was on the Central Branch Union Pacific Railroad, running west from Atchison, Kansas, during the year 1864, where the drainage was small. They gave excellent satisfaction; but during the next year cement pipes were brought to my notice, and as I could get a larger caliber of CEMENT PIPE than of stoneware, I concluded to give them a trial, but soon found they would not stand the frost; and, besides, after the water had cut through the glazing (or outer crust) of the pipe, they soon crumbled, until too weak to withstand the pressure of the bank, and then crushed.

"The stoneware pipe were generally in good condition in the fall of 1869, when I left the C. B. Road."

O. B. GUNN,
Chief Engineer Missouri, Kansas & Texas Railroad.

"MEMPHIS, TENN., March 18, 1872.

"My experience with stoneware pipe for use as culverts and drains for railroads extends back to

1859 and 1860, in which years I used some twelve or fourteen hundred feet of twenty-inch pipe in the construction of culverts in building the Mississippi & Tennessee Railroad.

"During the past year I have used one or two thousand feet of eighteen inch pipe in building culverts on the Memphis & Charlestown Railroad, some of them under twenty and thirty feet embankments.

"I have no hesitation in saying that when these pipes are properly laid down and the ends secured and protected with wing walls and aprons, they make by far the cheapest and most effectual drain for small water-ways for railroad use that can be found.

"As to the durability of the material, there can be no question, whenever thoroughly burned and vitrified."

NILES MERIWETHER,
Chief Engineer Memphis & Charlestown Railroad.

In the past few years, roads in this State have adopted them, and are equally well satisfied with their efficiency and economy.

We have, among others, supplied pipe to the Michigan Central; Michigan Air Line; Jackson, Lansing & Saginaw; Fort Wayne, Jackson & Sag-

inaw; Grand River Valley; Grand Rapids & Indiana, and Detroit & Milwaukee Railroads. The Engineers and Road Masters of the same state that it has afforded perfect satisfaction, having in *no case* failed, even under the test of the past two winters—the severest ever known.

We select the following from our testimonials, as it comes from the most northern portion of the State, where our pipe had the severest possible test:

"GRAND RAPIDS & INDIANA RAILROAD,
ENGINEER'S OFFICE,
FIFE LAKE, MICH., April 29, 1873.

"JACKSON FIRE CLAY CO., JACKSON, MICH.:

"I have deferred answering your inquiry with regard to our experience in the use of your vitrified sewer pipe for water-ways under our road-bed, until we had an opportunity of seeing the working of it through this spring.

"It is now two years since we commenced using your pipe, from 12 to 20 inches caliber, and have used them mostly since for small drains; have used them under heavy and light embankments, and, so far, have found them to answer our expectations well under embankments from three to twenty feet high.

"They have given us no trouble, except in one or two cases where the foundation was not sufficiently firm."

Respectfully yours,

M. M. STIMSON,
Civil Engineer.

In places where the ground is too soft or marshy to support the pipe in line, we find, by consulting those who have had the most experience, that the best method to prevent the settling of the pipe by the pressure of bank and weight of trains is as follows:

Lay two logs parallel with each other, a foot or so apart, and from twelve to twenty inches below the lower surface of the pipe, and cover with earth well tamped, until the required level is reached. In this earth, and between the lines of buried logs, bed the pipe. By this means, while there is earth enough to make a good bed for the pipe and give a bearing for its whole under surface, the stiffness of the logs will prevent the "sagging" of the pipe in the center, where the pressure is greatest; and the timber, being buried in wet earth and excluded from air, will be protected from rot and decay.

It is also well to face up the ends of the culvert with stone to prevent the washing away of the bank

from the end pipe by rains or by the action of the current.

Stone pipe are also extensively used by machine shops, for conducting the blast from the fan; also as smoke-jacks in round-houses and blacksmith shops, and for chimneys on small buildings—all of which are more fully explained under their appropriate heads.

STONE PIPE FOR WELLS.

Wells lined with stone pipe are impervious to insects, worms and surface water. When properly built, nothing can enter the well except from the bottom. Some persons, who have been accustomed to take from their wells yearly several hundred pounds of decayed vegetable and animal matter, ask: "How can a well, lined with small pipe, be *cleaned?*" To such we say: "If properly built they need no cleaning." This filth should not be allowed to enter the well. *It is as undesirable there as in our water pail or pitcher*, though less offensive to the eye.

DIRECTIONS FOR LINING WELLS.

Lay the pipe in a row on the level ground, adjusting the ends so that they will match perfectly. Dig the well as deep as practicable. Then settle the bottom pipe as low as possible. Fill the space outside of the pipe with clean gravel within two

inches of the top of the pipe. Lower the next pipe upon the first and cover the joint between the two (and cracks if defective pipe are used) with cement, packing the gravel around it carefully and filling up as before.

Ordinary dirt, instead of gravel, will do for filling after rising above the water veins that supply the well.

When the last pipe is in place, a layer, 15 or 20 inches deep, of coarse, washed gravel should be thrown into the well, to act as a filter, especially where the well terminates in quicksand.

Close the top securely with cement and stone or hard brick, so that no insects or surface water can enter, and the work is complete.

The drouth of the last two years has caused many wells to fail, that have formerly supplied an abundance of water. Such wells can be again made available by settling a pipe or two in the bottom. This may be done at little expense, and without any danger of undermining the old stone or brick wall.

DEFECTIVE PIPE FOR

SLUICES AND LAND DRAINAGE.

In long lines of city sewers, through which all manner of filth is conducted, (and sometimes with only a fall of one inch to the hundred feet) it is of the utmost importance that all the pipe forming the sewer should be well glazed and perfect in every respect.

In manufacturing for this trade, there are more or less pipe in every kiln that would be unfit for this purpose, but which are practically just as good for many uses as the most perfect pipe. Below we give price list, also a description and classification of the defective ware.

Class B.—In this class we put all sound, well-glazed pipe that are not perfectly cylindrical. Also pipe that are well glazed and round, but slightly fire cracked or air checked, just the thing

for wells, sluices, culverts under road-ways, or through deep cuts, &c.

CLASS C.—Perfect in every respect, but not glazed. They are made of the same FIRE CLAY as all our other pipe, but come from parts of the kiln which did not become sufficiently heated to produce the salt-glaze. They have all, however, been subjected to a heat that would melt any ordinary brick or "drain tile", and, unlike these, are not affected by water and frost. Are reliable for wells and ordinary water-courses.

CLASS D.—These pipe have the defects mentioned in Class B, but to a greater extent. Can be used for the same purposes as Class B, in the more shallow drains, where a failure would not cause serious trouble.

CLASS E.—Unglazed and round, but either fire or air cracked.

CLASS F.—These pipe are hard burned and very much flattened, and should only be used for the passage of clear water, as in draining cellars, wet land, &c. A 6-inch pipe in this class would have fully the capacity of a perfect 4-inch pipe.

"Fire cracks" are open checks, generally but a few inches long, and do not materially affect the strength of the pipe. "Air cracks" run the entire

length of one side of the pipe, but are so fine they can only be detected by the closest observation, or "sounding" the pipe.

In ordering from any class, parties can choose the sound or the cracked as they prefer, bearing in mind that a sound pipe (except from Class C) will not be so perfect in shape as one that is either fire or air checked.

When properly laid they cause no further trouble or expense, and form a smooth, continuous tube, giving the least possible resistance to the flow of water. In deep cuts, a large share, if not *the entire cost* of the pipe is saved in the economy of preparing the ditch. It is the cheapest article that can be used for a permanent underground drain, and free from the objections to an open ditch, which defaces the land, interferes with its cultivation, and is difficult and expensive to maintain, besides being comparatively useless during the winter season. See directions for laying, page 13.

Net Price Per Foot for Defective Pipe, without Rings, Delivered on the Cars at Jackson.

Calibre of Pipe	Class B	Class C	Class D	Class E	Class F
4 in.	$.13	$.10	$.10	$ --	$ --
6 "	.18	.15	.12	.08	.08
9 "	.35	.25	.22	.12	.12
12 "	.50	.35	.30	.18	.18
15 "	.70	.50	.40	.25	.25
18 "	.90	.75	.60	.30	.30
20 "	1.25	1.00	.87	.50	.50
22 "	1.50	1.25	1.00	--	--

We furnish broken rings with defective pipe, when desired, at an additional charge of ten per cent. to the face of the bill.

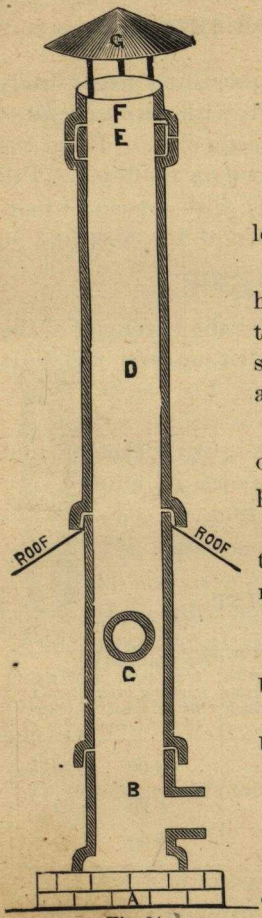


Fig. 24.

PORTABLE
STONE CHIMNEYS
AND
SMOKE JACKS.

Neat, Cheap, Light and Durable.

They can be made any length.

Suspended by three iron hooks attached to the bottom they form a neat and durable smoke-jack for engine-houses and blacksmith shops.

Starting from the ground or a shelf, they form a complete chimney.

They may also be used to top out brick flues above the roof.

A, shelf, covered with brick.

B, joint, one foot long, with branch for connecting stove-pipe.

C, joint, two feet long, with branch for connecting stove-pipe.

D, roof section.

E, coupling ring.

F, top section.

G, a heavy sheet-iron wind-cap.

DIRECTIONS FOR SETTING.

Fasten the shelf, **A**, (see preceding page) firmly where desired, and cover it with two courses of brick, laid in mortar or plastic clay. Place the lower pipe with the socket end on the brick. Fill the socket of the second pipe with cement or mortar, and place it over the top of the first, and so continue.

Fit the roof up neatly under the lower end of the socket of roof section, so that no rain will beat down by the side of the pipe.

Place the ring, **F**, in the upper socket of roof section, and the top section over it, filling every joint well with cement or mortar.

PRICE LIST.

Inside Diameter.	Straight pipe per foot, with sockets.	Joints, with stovepipe connections, each	Top sections, 5 feet high, including everything above the roof, each.	Weight per foot.
6 in.	$.30	$1.25	$4.00	20 lbs.
9 "	.50	2.00	6.00	35 "
12 "	.75	3.00	8.00	50 "

In ordering joints for stovepipe connections,

make *special* mention of the length desired, otherwise we always send two-foot joints, as shown at C.

Short ones are sometimes desirable for the more convenient arrangement of stove pipes.

SOCKET PIPE.



Fig. 23

A SOCKET PIPE is one with a fixed collar on one end, as shown in Fig. 23. While the principle of fixed sockets is apt to strike the casual observer favorably at the first glance, they are not desirable except when used as perpendicular conductors. The *experience* of engineers, and, indeed, all who have largely used them, has proved them inferior to plain pipe with rings, in the following points:

1. They are much more liable to be damaged in handling.

2. It is more difficult to obtain a uniform drain surface.

3. It is almost impossible to fill in the joint with cement, so that it will be water-tight.

4. In making repairs or new connections it is necessary either to break a pipe or uncover and disturb many feet of sewer.

5. Contractors are apt to increase profits by *drawing joints*, as bystanders cannot well detect the fraud.

New York, Brooklyn, Philadelphia, Chicago, Washington and other cities, after a long experience, all give the preference to ring pipe, while most of them will not permit any socket pipe to be used within their jurisdiction.

We manufacture socket pipe, however, and can supply those who prefer them at the same prices as ring pipe.

EXPERIENCES

WITH CEMENT PIPE.

The principal ingredient of these pipe is sand or gravel, held together by various mixtures or chemical preparations, some of which are patented, and which are intended to become harder and more durable with age. For a short time they met with favor, on account of their cheapness, but experience has proven them to be very unreliable.

We here append extracts from the reports of two Government Engineers, which correspond with general experience:

Copy of report made by Chief Engineer Stratton, of the Washington Navy Yard, A. D. 1870:

"The cement pipe was subjected to a test of pressure, and by practical use in the ground, and it was found it would not stand one-third the pressure of clay pipe, and that the action of matter passing through it caused disintegration, and made

it rough—in some cases dissolving the material of which it was composed."

"WASHINGTON, D. C., April 12, 1872.

"HON. BOARD OF PUBLIC WORKS, WASHINGTON, D. C.:

"GENTLEMEN:—In compliance with your directions of this date, I have made a hydraulic test of cement pipe made by The American Water and Gas Pipe Company.

"A pressure of five pounds to the square inch forced the water through the pipe in several places, and three-fourths the way through the entire body of the pipe. Portions of it, submerged in water for twenty minutes, became so soft as to be readily torn to pieces with the hands. A portion of it, subjected to sulphuric acid, with 75 per cent. water, was very readily seen to yield under the test.

"Pieces of the pipe may be seen in my room."

(Signed) WM. H. CHASE,
Sup't of Sewers, &c.

THE CITY OF ST. LOUIS, having had some very bitter experience in the use of cement pipe, have prohibited its further use. J. B. Moulton, Esq., the Engineer of that city, under date of August 26, 1872, wrote to some thirty engineers of the principal

cities of the Union, asking for the result of their experience in the use of cement pipe. The testimony thus brought out is overwhelming in its denunciation of that article for sewerage purposes. We here quote enough to show the spirit of the whole correspondence on this subject:

"HARTFORD, CONN., Sept. 3, 1872.

"J. B. MOULTON, City Engineer:

"DEAR SIR:—Very recently our Board of Street Commissioners decided, on my recommendation, not to lay any more cement tile. I was led to give this advice from a general idea of their worthlessness, which has been proved in several cases when we have taken up such sewers, some of quite recent construction. We found length after length entirely crumbled, and others that we succeeded in lifting out of the trench would break with a very slight blow. I think your reasons all hold good, and are sufficient to condemn their use."

C. H. BUNCE,
City Surveyor.

"RICHMOND, VA., Sept. 3, 1872.

"MR. J. B. MOULTON:

"DEAR SIR:—Within the last year I have passed

through an experience in sewer piping, with a conclusion fully in accord with your own. My mind is settled on the superiority of stoneware pipes, and the uncertainties attending those of cement. I will not hereafter use the cement pipes in our city sewerage."

CHARLES H. DIMMOCK,
City Engineer.

"BOARD OF PUBLIC WORKS,
CHICAGO, August 27, 1872.

J. B. MOULTON, ESQ., City Engineer:

"DEAR SIR:—In conformity with your request of 26th, I send you the accompanying copy of a report I made on the 26th of July to our Board on the subject of cement sewers.

"Since then I have received a letter from the City Engineer of Cleveland, Ohio, who speaks very decidedly in favor of cement sewers, after an experience of three years with them in that city. I have also conversed with Mr. Wesson, who had charge of the sewerage department of the Croton Aqueduct Board for a number of years, and he speaks very decidedly against them. He told me that he dug down to quite a number in Jersey City and found every one more or less disintegrated on the outside.

"Yours very respectfully,

E. S. CHESBROUGH.

"'CHICAGO, ILL., July 26, 1872.

"'BOARD OF PUBLIC WORKS, CHICAGO:

"'GENTLEMEN:—The Secretary's letter of the 13th, informing me that you desire a report from me of the value, in my opinion, of cement pipes for sewerage purposes, has been received. I take it for granted that the Board meant cement pipe as compared with hard-burnt or vitrified clay, as no other kinds are used to any considerable extent in this country, though wood, asphalt and iron are, in particular localities, used for special reasons.

"'I have given personal attention to this subject for about twenty years, and have both conversed and corresponded with other engineers relative to it.

"'Cement pipe sewers have their advocates, and are used to a considerable extent in Brooklyn, Buffalo, Jersey City, New Haven, and other cities. Some have been laid twenty years, and are in good condition yet. Others have failed in less than three years. Similar failures occurred with hard-burnt clay pipes in England, where, for years after their introduction, there was strong opposition to them, until their manufacture was brought to comparative perfection. Now the use of these pipes in that country is very general, especially for house drains.

"'Either kind of pipe requires skill and faithfulness on the part of those in charge of the laying of the sewers. The ease, however, of judging of the suitableness of a burnt pipe for a sewer is much greater than in the case of a cement pipe; in fact, it is very difficult, if not impossible to be certain with regard to the cement pipe, while it is not so with regard to hard-burnt clay.

"'Cement pipes have been slowly disintegrated by certain gases and acids emptied into them. Some very striking instances of this kind occurred in San Francisco, where urine from privies was discharged into the cement pipes. Nothing of this kind has ever occurred, so far as I can learn, with well-burnt clay pipes.

"'My opinion is that hard-burnt or vitrified clay pipe should be preferred for sewerage purposes to cement pipe, because of the much greater certainty of getting a good article of the former than of the latter; and in this respect I have the concurrence of several distinguished members of my profession, who have come to their conclusions on the subject after years of observation and experience."

Respectfully submitted,

E. S. CHESBROUGH,
City Engineer.

"JERSEY CITY, September 3, 1872.

"J. B. MOULTON, ESQ.:

"DEAR SIR:—I would say that my experience has led me to the conclusion that vitrified, or glazed, pipes are superior in every particular, and I have ordinarily endeavored to use as little cement pipe as possible. There can be no real question of which is the best.

"I have given this subject the most thorough attention, and I am confident I am right, and time will prove it. Cement pipe never will answer a safe purpose until it can be manufactured so as not to become disintegrated after being laid in the trench and covered. I have known a sewer made of it to cave in, and make a most disagreeable state of affairs, from the fact of not knowing to what extent the break extended."

JNO. P. CULUDO,
Chief Engineer.

"OMAHA, NEB., Sept. 8, 1872.

"J. B. MOULTON, City Engineer:

"DEAR SIR:—This city has made but very little use of cement pipe of any kind; but the Omaha & Northwestern Railroad Company had in the neighborhood of 1,500 feet placed upon their road

some six months ago, all of which proved a failure, owing to their want of the requisite strength to support the pressure.

"From my observation of the pipe, I should not recommend it for sewerage purposes:

1. Because they are more or less subject to disintegration from acids.

2. Their peculiar construction requires a better class of skilled labor in the setting than is usually secured.

3. Their efficiency depends so much upon the peculiar selection of material entering into their composition that few manufacturers manage to secure a proper cement, and the necessary proportion of clean gravel or sand requisite in pipes for sewer purposes.

"Mr. R. C. Phillips, formerly City Engineer of Cincinnati, and now Chief Engineer of Public Works in the District of Columbia, while here lately, expressed himself to me as in favor of glazed pipe in preference to those of cement."

ANDREW ROSEWATER,
City Engineer.

"BALTIMORE, September 2, 1872.

"J. B. MOULTON, ESQ., City Engineer:

"SIR:—We have used the cement pipe manufactured in this city in two instances only.

"Our experience with the cement pipe has been such as to compel us to report unfavorably upon its future use.

"Two years ago we laid about 100 feet of the pipe, six inches diameter, for the purpose of drawing a spring; about six months ago we were obliged to open it for repairs, it having failed to drain, when we found it had softened or yielded to the action of the water to such an extent as to render two sections useless."

JNO. H. TEGMEGES,
City Engineer.

"OFFICE OF COMMISSIONER OF SEWERS,
CINCINNATI, August 28, 1872.

"J. B. MOULTON, ESQ., City Engineer:

"Our Commissioners of Sewers, as well as myself, are not in favor of using cement pipe for sewerage purposes, confining ourselves entirely to the use of glazed stoneware or vitrified pipe. We do

not think the cement pipe, for durability and its capacity to resist the action of acids and other deleterious substances which are committed to public sewers, has been sufficiently tested by time. And we have high authority for believing pipe made of burnt clay, glazed and vitrified, will last for centuries. In matters of this kind we do not care to experiment."

A. W. GILBERT.

"BOSTON, August 29, 1872.

"J. B. MOULTON:

"DEAR SIR:—The article manufactured here by Messrs. Day & Collins is as good a cement pipe as I have ever seen, but the best, I have no hesitation in saying, is inferior to good vitrified clay pipe.

"If I had charge of the sewerage works of this or any other city I should recommend the use of vitrified clay pipe in preference to cement, notwithstanding the difference in cost. I regard cement pipe as worthless unless made of the best materials, and even then it is not as good as the other."

N. HENRY CRAFTS,
City Engineer.

"TOLEDO, September 2, 1872.

"J. B. MOULTON, City Engineer:

"DEAR SIR:—Here the use of cement pipe was discontinued after a short trial, and the vitrified salt-glazed pipe exclusively used in the construction of our pipe sewers, connections, &c., which I think to be quite superior to any cement pipe which I have seen tested, in evenness of texture, firmness, durability and its qualities to resist the action of sewer acids."

H. C. THATCHER,
City Engineer.

"MINNEAPOLIS, MINN., September 2, 1872.

"J. B. MOULTON, ESQ.:

"DEAR SIR:—The experiments I have made with cement sewer pipe are, that I filled a pipe with salt and water, and found that salt acted on it so that I think it would *eat a hole through* in no very long time. Acids will have a greater effect on them. And I know of no means of ascertaining which are good and which are poor. In our city, here, for the above reasons, I recommended the use of vitrified stoneware pipe, which was adopted by the City Council."

H. H. CARSON,
City Engineer.

"NEWARK, NEW JERSEY, Sept. 4, 1872.

"J. B. MOULTON, City Engineer:

"DEAR SIR:—In this city we use for the smaller local sewers glazed stoneware pipe. No cement pipe whatever is used.

"I have used cement pipe in railroad drainage, and found that it broke easily. My opinion is that the stoneware pipe is decidedly preferable to the cement pipe for sewer purposes."

GUSTAV SCHELBACH.
City Surveyor.

"AUGUSTA, ME., September 3, 1872.

"J. B. MOULTON, City Engineer:

"DEAR SIR:—My opinion in regard to cement pipe is the same as your own. Have found the same difficulty in regard to the texture of the pipe not being equal. Any one can see at a glance that the cement pipe will absorb the acids of the sewer, which will certainly destroy them. Were the sewers under my charge I would certainly use the vitrified pipe *for their conducting power alone —the polished surface presenting but little resistance to the water and foreign matter.*"

N. ABBOTT,
City Engineer.

"PHILADELPHIA, Aug. 29, 1872.

"J. B. MOULTON, ESQ., City Engineer:

"DEAR SIR:—Cement pipe are manufactured here on a limited scale, but, so far as my observation goes, have not given satisfaction. So much care is required in obtaining good material and having them properly made that the quality cannot be depended on. Although somewhat cheaper than the vitrified pipe, there is so much uncertainty in them that I should not be willing to risk their general introduction.

"Cases have been reported to me of cement pipes where they have all had to be taken up, on account of their deterioration."

SAM'L L. SMEDLEY,
Chief Engineer.

ISAAC K. HAINES, Engineer, Lynn, Mass., says:

"We have never deemed it advisable to use cement pipe. We have used English, Scotch and American clay pipe. Our reasons for not using the cement pipe are that the texture is not uniform, it breaks easier than the stoneware pipe, and does not resist sewer acids as well."

Under a more recent date WM. H. CHASE, Sup't of Sewers and Drains, Washington, D. C., says:

"We use clay pipe exclusively. In all sizes of 12 inches and over we lay ring joints.

"We use both Scotch and American clay pipe, and, with sizes of 24 inches and less, have no trouble with breaking and crushing in.

"WE USE NO CEMENT PIPE, as the various chemical and hydraulic tests we have made do not commend it to our favor, and portions of it, uncovered by the change in grade of streets, which was put down under the old government, was found to be in such a state of decomposition as not to allow of being taken up."

WM. H. CHASE,
Sup't Sewers and Drains, Washington, D. C.

Should any desire further evidence as to the unreliability of cement pipe for sewerage purposes, we shall be pleased to furnish it upon application.

INADEQUATE SEWERAGE,

AND ITS

EFFECT ON MORTALITY.

We make the following extracts from the Chicago *Inter-Ocean* of Jan. 15, 1873:

"The Effect of Inadequate Sewerage in Increasing the DEATH RATE.

"The following extracts are from the report of Dr. John H. Rauch, Sanitary Superintendent of the Chicago Board of Health, on the sewerage system of the city:

"The necessity of the systematic drainage of Chicago was not fully appreciated until it had suffered from epidemics six years in succession, five of cholera and one of dysentery; the death rate during this period being higher than in any other

city in the United States. As the result of this terrible experience, on Feb. 14, 1855, an act was passed by the Legislature of Illinois, creating the Board of Sewerage Commissioners. In compliance with the act the Commissioners were elected as prescribed, and steps immediately taken to give practical effect to the same, in surveys and in the consideration of plans for the drainage of the city. The plan proposed by Mr. Chesbrough was adopted in December, and in 1856 the work of constructing sewers commenced. * * * *

"For the purpose of more clearly showing the influence of this, the most important sanitary movement ever inaugurated in this city, I would call attention to the fact that for the six years commencing in 1849 and ending in 1854 the death rate was 48.92 in a thousand, while for the next succeeding six years, *commencing in* 1856 *with the construction of sewers*, and ending in 1861, the death rate was only 22.97. * * *

"The Doctor thinks it is plain that the number of deaths in a ward *is regulated by the number of feet of sewers it contains to each individual in it*, no matter what other conditions obtain with regard to the population."

"At the last meeting of the Epidemological

Society, in London, in December, 1872, some very important facts were presented in regard to the spread of the cholera in Russia, by D. Frederick J. Mouatt, late Professor of Medicine and Medical Jurisprudence at Calcutta. * * *

"The Society contend that the wandering pestilence has abandoned its nomadic character in Europe and found a resting-place in St. Petersburg, where the houses, saturated with sewerage matter, invite its ravages."

From the scientific department of the *Galaxy* for March, 1873, we quote as follows:

"CEREBRO SPINAL MENINGITIS.

"Regarding the epidemic of 1872 in New York city, Dr. Meredith Clymer says:

* * "The chief nests of the epidemic were in those districts in which the original water-courses had been dammed by the filling up of the streets and avenues, and over the adjoining water-saturated land.

"Most of the cases of the disease were grouped on and about the made land, originally marshes.

"One of the most striking examples is in Collect Place, a swampy spot in the Fourth Ward. Base-

ments over these marshy places are never dry, and the walls are often covered with cryptograms (moss and mold). In those districts where these factors were absent, the elected haunts were densely populated tenement dwellings, in which the house drainage was *invariably* found in bad condition. The part played by the diffusion of foul sewer gases in favoring the development of the disease would seem, by the collected evidence, to be unquestionable.

"Throughout the Northern States this disease is known as the Spotted Fever; in the South as the Cold Plague; in Europe by various technical and local names; and in all countries as one of the most deadly affections to which mankind is subject.

"Like epidemic diseases in general, it is no doubt preventable." * * * * *

Dr. Morris, on the same subject, says: "Wherever we have carefully examined the local conditions, it has been found that the drainage of the premises has been faulty, or that the immediate surroundings have presented such conditions as must necessarily give rise to some form of disease. The most usual defects discovered were connected with house drainage.

"These cases were not confined to the abode of the dirty, squalid and poor, but houses of a better

class, with brown stone fronts, have furnished their victims."

The above extracts are only a few from among the many with which our scientific and medical journals abound.

It has long been understood that the more malignant types of fevers and kindred diseases have their origin in causes which it is the office of the sewer to remove.

Late special investigations regarding new forms of disease, of the more virulent and dangerous kinds, whether confined to a single home or affecting a whole city, prove them also to be, in a great measure, if not entirely, controlled by the condition of the sewerage.

FIRE BRICK

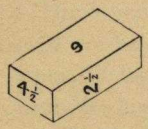
AND

FIRE BRICK MATERIALS.

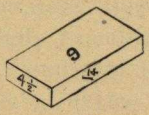
Having the best deposits of fire brick material, we are prepared to furnish better

FIRE BRICK

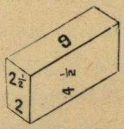
than have heretofore been made in the West.



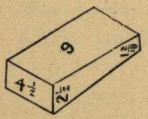
Standard.



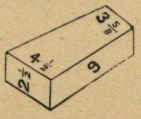
Split.



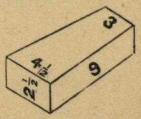
Arch.



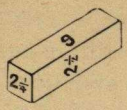
Wedge or Bullhead.



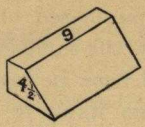
Key—8 ft. Circle.



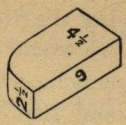
Key—6 ft. Circle.



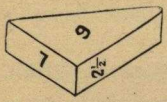
Soap.



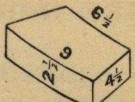
Skewback.



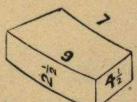
Small Jamb.



Large Jamb.



Cupola—36 in. Circle.



Cupola—48 in. Circle.

PRICE per M. for the above sizes, on the cars at Jackson, - - - - $50.00

Brick of any size or shape made to order. The prices of large sizes are from 50 to 100 per cent. higher, *by weight*, than for standard size.

Brick should be laid as close together as possible, "brick to brick," using only enough clay to cement them together.

We have many testimonials, assuring us that for most purposes they are equal to the New Jersey brick, which cost from $75 to $80 per thousand.

"OFFICE JACKSON FOUNDRY & MACHINE CO., }
JACKSON, MICH., March 28, 1872. }

"JACKSON FIRE CLAY CO.:

"GENTLEMEN:—In reply to your inquiry regard-

ing the fire brick purchased of you Nov. 5, 1869, we would say that the same brick are still in our cupola, which has been in regular use ever since, and that they seem likely to last for some time longer."

E. A. SUMNER, Sec'y.

Mr. F. L. COLLINS, Sup't Lake Shore & Mich. Southern Railroad Foundry at Elkhart, Ind., says: "I have just removed a lining from one of our cupolas, made of your brick. They have melted from four to nine tons of iron daily for nine months.

"The brick last received look still better."

PREPARED FIRE CLAY.

Our DRIED AND ROLLED CLAY is of the best quality, and will enable those buying large quantities to make a saving in freight. It is also the most convenient form in which to keep it for frequent use, as it will not harden if kept dry, and will mix readily with water when desired for use.

PRICE per barrel, in small lots, - - $3.00

For ordinary uses, and in laying fire brick, it should be mixed with one-third of best fire sand, which we also keep on hand, dried and crushed.

PLASTIC CLAY

Is more desirable for immediate use and where only a small quantity is needed. It is made of the best fire clay and fire sand, ground and thoroughly pugged, ready for the trowel.

PRICE per barrel, in small lots, - - $3.00

Crude clay, direct from the bank, furnished when desired.

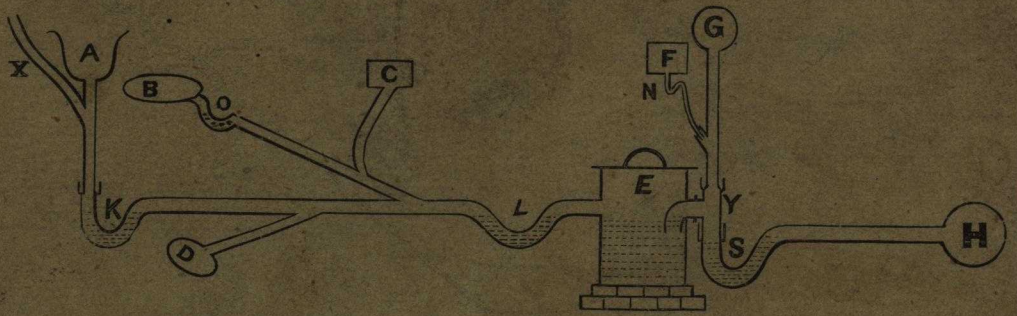
FIRE SAND.

Our fire sand is unsurpassed in quality. Can ship it at any season of the year, either in lumps as it comes from the quarry, crushed—by passing through rollers,—or rolled and screened.

PRICE per barrel, in small lots, - - $2.00

For larger lots, prices given when quantity and kind are stated.

SEWERAGE ILLUSTRATED.



For description see page 24.

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